

Remarks

Applicants acknowledge the restriction requirement dividing the application into two groups, namely, Group I directed to Claims 1 - 9 and Group II directed to Claims 10 - 12. The Applicants confirm the earlier election of Claims 1 - 9 for immediate prosecution. Claims 10 - 12 are cancelled.

The Applicants acknowledge the Examiner's helpful comments with respect to 35 U.S.C. §112 and have amended Claims 1 and 7 as suggested. Claim 1 has been amended to delete "selected" and Claim 7 has been amended to correct the typographical error.

Claim 1 has further been amended to recite a method of remediating media including forming Fe-S based inorganic compounds mainly comprising sulfur on at least portions of surfaces of iron powder containing about 0.1% to about 2% by mass of sulfur, contacting the halogenated hydrocarbons contained in the media with the iron powder and causing reduction of halogenated hydrocarbons at the surfaces to thereby dehalogenate the halogenated hydrocarbons. Support may of course be found in original Claim 1 and the Specification in ¶¶23 and 24, spanning pages 7 - 8 and ¶28. Claim 4 has been cancelled.

Table 1 in the Specification has been amended in view of the amendments to Claim 1.

According to the claimed invention, iron powder containing about 0.1 to about 2 wt% of S and having Fe-S based compounds on its surface is contacted with contaminated media, thereby causing chemical reaction at the surface of the iron powder, which causes dehalogenation of halogenated hydrocarbons. With such a method, excellent efficiency in dehalogenation can be obtained as shown in Table 1 (Examples 2 to 6).

Although the reasons are not fully understood, the Applicants believe that electrical activity at the surface of the iron powder enhances local cell reactions in which the Fe-S based compound

functions as cathodes and the Fe portion of the surface functions as anodes (see ¶s[0023] and [0024]). To achieve this remarkable result, the S content in the iron powder should be about 0.1 to about 2 wt% ([0028]).

The Applicants respectfully submit that as amended, Claim 1 distinguishes over Wolfe '882, JP '401 and Sivavec '927. The Applicants respectfully submit that none of the three publications discloses, teaches or suggests the specifically recited steps from Claim 1. Careful scrutiny of all three publications reveals that none of them had any appreciation for the Applicants' specifically claimed steps, much less provide any teachings or suggestions to those of ordinary skill in the art that would lead toward such steps.

The Applicants note with appreciation the Examiner's detailed and helpful comments with respect to Wolfe '882 and the mixtures of metal and sulfur containing compound utilized to remediate environmental contaminants. Unfortunately, the fact that Wolfe '882 discloses the use of iron and Fe-S₂, provides no guidance to those of ordinary skill in the art leading to the invention as recited in Claim 1. Wolfe '882 discloses a method of dehalogenating halogenated hydrocarbons by affecting metal (such as iron) and sulfur (or sulfur-containing compound) (Column 3, lines 36 to 47). However, in sharp contrast to the claimed invention, it appears that mainly the metal functions as the chemical reaction site for dehalogenation, and that sulfur functions to control pH of the entire system (Column 5, lines 16 to 19, and Column 6, lines 6 to 15). Consequently, the mode of co-existence of the metal and sulfur in the method in Wolfe '882 has wide latitude, including separate addition, providing as a mixture, and as a single compound (Column 3, lines 36 to 47, and Column 5, lines 29 to 36).

Wolfe '882 does not specifically disclose iron powder containing about 0.1 to about 2 wt% of S and having Fe-S based compound on its surface. Wolfe '882 also does not disclose unexpected results as shown in Table 1. Specific examples which appear to be the nearest to this invention are:

(a) Commercial iron (powder) containing "some" sulfur (Column 6, lines 32 to 36, Column 9, line 24 to Column 10, line 47, and Table 1, etc.), and

(b) Commercial iron (powder) or pure iron (powder) to which iron sulfide such as pyrite is added (Column 6, line 36 to Column 7, line 5, Example 2, Table 3, etc.).

Regarding (a), however, the specific content of sulfur is not disclosed. Further, commercial iron also contains "some" Mn, which means Mn-S based compounds are likely to appear instead of Fe-S based compounds, as explained in the Applicants' Specification at ¶[0065]. Besides, Wolfe '882 specifically identifies Fisher Scientific as the provider of the commercial iron fillings or powder. From the attached pages of the Homepage of Fisher Scientific, the product powder seems to be electrical powder, and creation (precipitation) of surface sulfide does not likely occur compared to atomized powder. Consequently, specific example (a) does not teach or suggest this invention as recited in the solicited claims.

Moreover, the result of using commercial iron powder alone shown in Table 1 exhibits rather poor results compared to other examples such as the ones in Table 2. Thus, the result also implies that this claimed invention is not inherently achieved by specific example (a).

Further, to achieve good results for metal containing S as an impurity, S of 5% or more (which is much more than normal content in commercial iron) is suggested in Column 3, lines 53 to 55.

Regarding (b), only mixtures (not precipitates as the Official Action asserts) of iron powder and pyrite are disclosed in Wolfe (Column 6, lines 44 to 47 and lines 63 to 66, Column 7, lines 15 to 19, and Column 12, lines 31 to 34, and lines 57 to 60). Further, the specific content of mixed sulfur is about 2.5 to 10 wt% from Column 7, lines 15 to 19 and Column 12, lines 31 to 34, and lines 57 to 60. Thus, specific example (b) is not only different in the form of iron and sulfide, but also appears to need more sulfur than this invention to achieve a preferred result.

Regarding the preferred S content of "0.1 to 25 wt%" in Column 6, lines 43 to 49 that the Examiner helpfully point out, only addition of S in solution as shown in Table 2 is disclosed for the example of minimum addition (around 0.1% sulfur). As the function of controlling pH, it is reasonable that solute sulfur is more effective than solid sulfur. As a solid content, it appears that at least 2.5 wt% of sulfur is preferable no matter whether type (a) or (b) is employed.

As a consequence of the above-identified sharp differences of the invention over Wolfe '882, there is nothing in Wolfe '882 that would provide one of ordinary skill in the art with a reasonable expectation of success with respect to the claimed steps taken from amended Claim 1. Withdrawal of the rejection based on Wolfe '882 is accordingly respectfully requested.

JP '401 is similarly deficient. Careful scrutiny of the entire JP '401 disclosure (as provided by the translation) reveals that there is utterly nothing in that disclosure that would lead one of ordinary skill in the art to the steps recited in solicited Claim 1. In sharp contrast, JP '401 concentrates more on P compounds as opposed to the steps recited in amended Claim 1. In particular, in the method disclosed in JP '401, contaminants such as P compounds are reacted with solute iron derived from iron powder, and form a sediment, and removed by filtering. See [0002] to [0005] and [0024]. Thus, the method in JP '401 uses completely dissimilar mechanisms to

remedy the contaminated media.

Further, the iron powders used in JP '401 do not likely have Fe-S based compounds on the surface because Mn content is relatively high as shown in Table 1 through Table 5. In that regard, it should be understood that, without any clue that Fe-S is much preferred over Mn-S, decreasing the Mn content to about 0.1 wt% or less is hardly obvious. The Applicants therefore respectfully submit that the solicited claims are clearly patentable over JP '401 and respectfully request withdrawal of the rejection based on that publication.


Sivavec '927 is, once again, similarly deficient inasmuch as there are no teachings or suggestions to those of ordinary skill in the art that would lead to the invention as recited in the solicited claims. Utilization of pure iron powder is utterly unnecessary in the invention and, in any event, there is nothing in Sivavec that teaches or suggests the Applicants' specifically claimed steps. In fact, we respectfully submit that Sivavec (as well as Wolfe '882 and JP '401) are so completely devoid of disclosure with respect the recited steps that they are non-enabling. One of ordinary skill in the art, when viewing those publications, would have no idea of how to achieve the specifically recited steps of the solicited claims. Sivavec '927 only shows the method using an admixture of iron and ferrous sulfide to maintain pH, for dehalogenation (Column 2, line 62 to Column 3, line 4). Thus, it is only one embodiment of the method shown in Wolfe '882 (especially, type (b)).

Regarding the S content, the preferred range is 10/1 to 5/1 in iron metal/iron (II) sulfide (Column 3, lines 45 to 54), which is about 4.9 to 8.7 wt% in S content in the admixture. The S content in the admixture in Example 1 is about 8.7 wt% and in Example 2 is about 2.9%. In Example 3, the S content is widely varied, but only 3.3 to 6.1 wt% of S (2.50 to 5.00 g sulfide to 25.0 g iron filings) resulted in required pH range. Again, a higher S content than in this claimed invention

is preferred. Withdrawal of the rejection based on Sivavec '927 is respectfully requested.

In light of the foregoing, we respectfully submit that the entire application is now in condition for allowance, which is respectfully requested.

Respectfully submitted,


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